RDT&E Division

San Diego, CA 92152-5000







Technical Document 2324 August 1992

Hybrid Microcircuit Assembly Manufacturing Process Parameters Data List

Treese and Associates, Inc.

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NAVAL COMMAND, CONTROL AND OCEAN SURVEILLANCE CENTER RDT&E DIVISION

San Diego, California 92152-5000

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ADMILISTRATIVE INFORMATION

This document describes a study conducted during January 1992 by Treese and Associates, Inc., 275 Orange Avenue, Goleta, California 93117, as a sub-contractor to Computer Sciences Corporation. Treese and Associates, Inc., performed the study to complete contract N66001-89-C-0061, which was sponsored by the U. S. Navy Manufacturing Technology Program (MT) and administered by the Manufacturing and Computer Integrated Engineering (CIE) Technology Branch, Code 936, of the Naval Command, Control and Ocean Surveillance Center, RDT&E Division (NRaD), San Diego, California 92152-5000. Technical assistance and program monitoring for the study were provided by R. L. McCollough and C. C. Azu, Jr., of NRaD Code 936. This document was developed during the Microelectronic Computer Integrated Manufacturing (MCIM) Program, and it supports "Hybrid Microcircuit Application Protocol," written by the National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland.

Released by M. E. Nunn, Head Manufacturing and Computer Integrated Engineering (CIE) Technology Branch Under authority of C. I. Ward, Jr., Head Design and Development Division

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1.0 Introduction

The Hybrid Microcircuit Assembly manufacturing process parameters have been established in order to bring about their recognition and control. The list is of generic thin film, thick film and multi-chip modules constructed with multi-layer green tape alumina and substrates. The list starts with substrate fabrication and progressing through to final assembly, inspection, and test. Once the parameters have been fully recognized and completely described, progress can be made in regulating the parameters. This regulation will bring about cost effective requirements and a higher quality product. Another benefit will come from knowing the parameters that need further scrutiny. The possible combining of manufacturing functions or techniques can in the future change the parameters but the new parameters can be compared with the old.

There are eleven separate categories in the list and they are defined as follows:

OPERATION NUMBER - provides a four digit number to identify process steps. Will be used for process flow analysis and throughput calculations.

PROCESS DESCRIPTION - identifying name of process step.

PROPERTY - primary manufacturing properties of the process.

UNITS OF MEASURE -the units of measure of the process parameters. TYPICAL VALUE/RANGE - the typical value or range of values of the generic process parameters.

SPC FORMAT - the method of measuring and tracking the process conditions for statistical process control.

DATA (ACQUISITION) - the typical method or equipment for fabrication, assembly, inspection and test in today's hybrid microelectronic manufacturing facility.

PROCESS TYPE - the typical method or equipment for fabrication, assembly, inspection and test in today's hybrid microelectronic manufacturing facility.

CONTROLLING DOCUMENT - the contractually imposed specification, applicable to the process operation or to the specific property in that operation.

CAD (LAYER) - nomenclature specified in the "IGES HMA Application Protocol" for the process or the specified property.

IDEF (NODE) - the IDEF node(s) being specified in the "IGES HMA Application Protocol".

2.0 Thin film manufacturing process parameters

After having selected the substrate material, the next step in the fabrication of thin film microcircuits is the deposition of metals or metal compounds onto the substrate. These metals ultimately provide the conductor and resistor patterns and functions. Typically, a substrate is coated sequentially with a layer of resistive material, a barrier metal layer, and a top conductor layer. These layers are relatively thin ranging from 200A to 20,000A. The layers are deposited by one of the following methods, Vapor Deposition, Direct Current Sputtering, Radio-Frequency Sputtering, and Reactive Sputtering or variations of the processes. The following is a list of processing parameters used for thin film substrates for Hybrid Microcircuits. An attempt has been made to keep the list generic so as it does not represent anyone manufacturers processing ways.

GENERIC, THIN FILM FABRICATION PROCESS FLOW

OPERA- TION #	PPOCESS DESCRIPTION	PROPERTY	UNITS OF MEASURE	TYPCAL VALUE/RANGE	SPC FORMAT	DATA	PROCESS TYPE	CONTROLLING DOCUMENT
2010	IDENTIFY SUBSTRATE	Alpha-numeric & bar code images	\$String\$	ż				
2010		Marking locations	ż	?				
2010		Legibility	ć	٤				
2020	CLEAN SUBSTRATE	2	2	2				
2030	SCREEN CIRCUIT LAYER	Screen mesh	Wires/Inch	3			Automatic	
2030		Screen tension	5	i			Autometic	
2030		Screen breakaway distance	Mils	ż			Automatic	
2030		Squeegee applied pressure	Lbs/sq.in / linear in.	1-10 psi/in. of squeegee		1	Automatic	
2030		Squeege deposition velocity	Inches/second	2-6			Automatic	
2030		Squeegee hardness	Durometers	2			Autometic	
2030		Substrate to screen distance	Mils	5			Automatic	
2030		Number of squeegee passes	Unitless	1, 2, or 3			Automatic	
2030		Material properties		7	X bar-R	Manuel	Automatic	
2030		Material properties	٠	7	X bar-R	Manual	Automatic	
2030		Minimum layer thickness	Mils	2			Automatic	
2030		Maximum layer thickness	Mils	ż			Automatic	
2030		Emulsion thickness on screen	Mils	2-3			Automatic	
2030		Screen weave angle to substrate	Angular degrees	22, 45, or 90			Automatic	
2030		Substrate registration to screen	X-mils, Y-mils	ć			Automatic	
2030		Screening defects	ż	ć	d.			
2040	DRY CIRCUITRY	Environment	\$Strings\$	Oven, IR lamps, etc.			Batch	
2040	(to remove volatiles)	Drying temperature	Degrees C	180			Batch	
2040		Drying time	minutes	5-15			Batch	

2040		Drying wavelength (IR)	Microns	>3			Batch	
2050	FIRE CIRCUITRY	Environment	\$String\$	Oven, furnace, etc.				
2050		Temperature profile	Time vs Degrees C	5 min a 300 C, etc.				
2060	INSPECT CIRCUITRY	Conductor conductivity	Volts	2	X bar-R	Manual		
2060		Wire pull strength	Grams	ż	X bar-R	Manual		
2060		Solderability	٤	ż	X bar-R	Manual		
2070	SCREEN PASSIVATION LAYER	Coreen mesh	Wires/inch	ż			Automatic	
2070		Screen tension	٤	2			Automatic	
2070		Screen breakaway distance	Mils	2			Automatic	
2070		Squeegee applied pressure	lbs/sq.in per linear inch	1-10 psi/in. of squeegee			Automatic	
2070		Squeege deposition velocity	Inches/second	2-6			Automatic	
2070		Squeege hardness	Durometers	ئ			Automatic	
2070		Substrate to screen distance	Mils	خ			Automatic	
2070		Number of squeege passes	Unitless	1, 2, or 3			Automatic	
2070		Material properties	2	ن			Automatic	
2070		Minum Layer thickness	Mils				Automatic	
2070		Maximum layer thickness	Mils	2			Automatic	
2070		Emulsion thickness on screen	Mils	2-3			Automatic	
2070		Substrate registration to screen	X-mils, Y-mils	غ			Automatic	
2070		Screen weave angle to substrate	Angular degrees	22, 45, or 90			Automatic	
2070		Material viscosity	Centipoise	7	X bar-R	Manual		
2080	DRY PASSIVATION LAYER	Environment	\$ String \$	Oven, IR lamps, etc.				
2080		Drying temperture	Degrees Centigrade	180				
2080		Drying time	Minutes	5-15				
2080		Drying wavelength (IR)	Microns	>3				
2090	FIRE PASSIVATION LAYER Environent	Environent	\$Srings\$	Oven, furnace, etc.				

2090		Temperature profile	Time vs degrees	5 min. @ 300 C, etc			
2100	INSPECT PASSIVATION	Crossover capacitance	Farads	2	X bar-R Ma	Manual	
2100		Dielectric breakdown	Volts	١	X bar-R Ma	Manual	
2110	APPLY EPOXY	-	ć	2			MIL-STD-883, METHOD 2019.4
2120	ATTACH RESISTOR CHIPS	2	ż	7			MIL-STD-883,METHOD 5011.
							MIL-STD-883,METHOD 2017.7
							MIL-STD-883,METHOD 2011.5
2130	OVEN CURE	•	,	2			MIL-STD-883,METHOD 2017.5
2140	WIRE BOND RESISTORS	Bond height	Z-mils	10			MIL-STD-883, METHOD 2023.3
2140		Bonding force - first & second bond	Grams	10			MIL-STD-843, METHOD 5003
2140		Bonding power	Microinches	0-250			
2140		Bonding time	Milliseconds	100			
2140		Location of first bond	X-mils, Y-mils	٤			
2140		Location of second bond	X-mils, Y-mils, Z-mils	2			
2140		Loop height, loop length	Mils/mils	6-20/10-200			
2140		Tail length	Mils	2			
2140		Wire diameter	Mils				
2140		Wire material	\$String\$	Gold or Aluminum			
2140		Wire doping material/percentage	\$ String \$	Silicon/1.0%			
2140		Wire material purity	Percent purity	66.66			
2140		Wire elongation	Percent	3-7			
2140		Wire tensile strength	Grams	15			
2140		Time from last cleaning operation	Hours, date (yymmdd)	16, 910322			
2140		Bond signature	٤	ć			
2150	TRIM RESISTORS, ACTIVE	TRIM RESISTORS, ACTIVE Name of component to be trimmed	\$String\$	R17	-	Automatic	atic
2150	(Using Laser Process)	Location of start of trim	X-mils, Y-mils	XX.XX, YY.YYY		Automatic	atic
2150		Coordinate data for path of trim	X-mils, Y-mils	кк.ккк, уу.ууу		Automatic	atiq

2150		Pulse repetition rate	kilohertz	35	Automatio
2150		Resistor trim geometry	\$ String \$	"L", :J", or Plunge Cut	Automatic
2150		Type of laser used in trimming	\$ String\$	YAG, Co2, etc.	Automatic
2150		Laser power, maximum	Watts	15	Automatic
2150		Laser power, minimum	Watts	12	Automatic
2150		Spot size	Microns	0.002	Automatic
2150		Target resistance	Ohms	1000	Automatic
2150		Target resistance tolerance	Ohms	0.1	Automatic
2150		Trim speed, course	Mils/second	e/ u	Automatic
2150		Trim speed, fine	Mils/second	n/a	Automatic
2150		Trim kerf width	Mils	0.002 (spot size)	Automatic
2150		Trim width, minimum	Mils	+/- 0.010	Automatic
2150		Parameter to be measured	\$ String \$	3.5 vdc at TP1	Automatic
2150		Tolerance of parameter measured	\$ String \$	+ 0.02 vdc	Automatic
2150		Operating conditions for trim	\$String\$	Vcc=5.0, at -55 C	Automatic
2160	INSPECT	2	ć		
2170	TO NEXT ASSEMBLY OR STORES	n/a	n/a	n/a	
	FOR MUTI-LAYER SUBSTRATES:				
2290	IDENTIFY SUBSTRATE	٤	ć.	ż	
2210	CLEAN SUBSTRATE	2	٤	ż	
2220	SCREEN CIRCUIT LAYER	Screen mesh	Wires/inch	ć	Automatic
2220		Screen tension	ċ		Automatic
2220		Screen breakaway distance	Mils	ċ	Automatic
2220		Squeegee applied pressure	Lbs/sq.in per Linear inch	1-10 psi/in. of squeegee	Automatic
2220		Squeegee hardness	Durometers	ć	Automatic
2220		Substrate to screen distance	Mils	ć	Automatic
2220		Number of squeegee passes	Unitless	1, 2, or 3	Automatic

2220		Material properties	ć	•	X har-P	Name of Street	Automotio	
2220		Material properties	ć	2		Hanual	Manual Automatic	
2220		Minimum layer thichness	Hils	٤			Automatic	
2220		Maximum layer thickness	Mils	Į.			Automatic	
2220		Emulsion thickness on screen	Mils	2-3			Automatic	
2220		Screen weave angle to substrate	Angular degrees	22, 45, or 90			Automatic	
2220		Substrate registration to screen	X-mils, Y-mils	5			Automatic	
2220		Screening defects	5	٤	МP		Automatic	
2230	DRY CIRCUITRY	Environment	\$ String \$	Oven, IR lamps, etc.		_		
2230		Drying temperature	Degrees Centigrade	180				
2230		Drying time	Minutes	5-15				
2230		Drying wavelength (IR)	Microns	>3				253101
2240	FIRE CIRCUITRY	Environment	\$String\$	Oven, furnace, etc.				0.002
2240		Temperature profile	Time vs degrees C	5 min. a 300 C, etc.				
2250	INSPECT CIRCUITRY	Conductor conductivity	Volts	٤	X ber-R	Manuat		
2250		Wire pull strength	Grams	?	X ber-R	Manual		
2250	(Repeat Above 4 Operations For	Additional Layers As Required)						-1-711
5260	SCREEN DIELECTRIC LAYER	Screen mesh	Wires/inch	?			Automatic	
2260		Screen tension	ż	?			Automatic	
2260		Screen breakaway distance	Mils	2			Automatic	
2260		Squeegee applied pressure	Lbs/sq.in per linear inch	1-10 psi/in. of squeegee			Automatic	
2260		Squeegee deposition velocity	Inches/second	2-6			Automatic	-11
2260		Squeegee hardness	Durometers	خ			Automatic	
2260		Substrate to screen distance	Mils	٠			Automatic	II.v Pr
2260		Number of squeegee passes	Unitless	1, 2, or 3		1	Automatic	- E.
2260		Material properties	2	٠	X bar-R	Manual	Automatic	

degrees 22, 45, or 90 Y-mils 7 Ss Oven, IR lamps, etc. Gegrees 5 min. a 300 C, x bar-R Manual 7	2260		Material viscosity	Centipoise	2	X bar-R	Manual	Automatic	
Fire Dielectric LAYER Emulsion thickness on screen Miles 2-3	2260		Minimum Layer thichness	Mils	i		1	Automatic	
Screen wave angle to substrate Mils 2-3	2260		Maximum Layer thicknes	Mils	٤			Automatic	
Streen weave angle to substrate Angular degrees 22, 45, or 90	2260		Emulsion thickness on screen	Mils	2-3			Automatic	
DRY DIELECTRIC LAYER Environment Storings* Oven, IR Lamps, etc. PR PRY DIELECTRIC LAYER Environment Setrings* Oven, IR Lamps, etc. PR FIRE DIELECTRIC LAYER Environment Minutes 5-15 PR FIRE DIELECTRIC LAYER Environment Strings Oven, furnace, etc. PR LAYER Temporature profile Time vs degrees 5 min. a 300 C, A bar-R Manual LAYER Temporature profile Time vs degrees 5 min. a 300 C, A bar-R Manual Geperations for Each Additional Circuit Layer) Volts 7 X bar-R Manual Operations for Each Additional Circuit Layer) 2 7 X bar-R Manual Operations for Each Additional Circuit Layer) 2 7 X bar-R Manual Operations for 2 7 7 A tar-R Manual ATTACH RESISTOR CHIPS 7 7 A tar-R Manual OVEN CURE 7 7 7 A bar-R Manual MIRE BOND RESISTOR CHIPS 7 7 7	2260		Screen weave angle to substrate	Angular degrees	45, or			Automatic	
DRY DIELECTRIC LAYER Environment SST ings\$ Over, IR lamps, Etc.	2260		Substrate registration to screen	X-mils, Y-mils	٤			Automatic	
Drying temperature Degrees 180		DRY DIELECTRIC LAYER	Environment	\$Strings\$	2	-		Batch	
Drying time Nitutes 5-15	2270			Degrees Centigrade	180			Batch	
FIRE DIELECTRIC LAYER Environment	2270			Minutes	5-15			Batch	
FIRE DIELECTRIC LAVER Environment	2270		Drying wavelength (IR)	Microns	>3			Batch	
Higher office Time vs degrees 5 min. a 300 C, C Cossover capacitance Farads 7		FIRE DIELECTRIC LAYER	\rightarrow	\$String\$	Oven, furnace, etc.				
Harbert DIELECTRIC Crossover cabacitance Fareds 7	2280		Temporature profile	Time vs degrees C	n. a 300				
(Repeat Above 4 Operations of integral Above 4 Operations for Apply Epoxy Each Additional Circuit Layer) 7		INSPECT DIELECTRIC LAYER	Crossover capacitance	Farads	ż	bar-R	Manual		
(Repeat Above 4) Each Additional Circuit Layer) 7 7 APPLY EPOXY 7 7 7 ATTACH RESISTOR CHIPS 7 7 7 OVEN CURE 7 7 7 UNIRE BOND RESISTORS 8 bond height 2-mils 10 WIRE BOND RESISTORS 8 bond height 2-mils 10 Bonding fonce- first & second bond 4 microinchess 0-250 Bonding time Miliseconds 100 Location of first bond X-mils, Y-mils, 7-mils, 7	2290		Dielectric breakdown	Volts	٤		Manual		
ATTACH RESISTOR CHIPS 7 7 7 ATTACH RESISTOR CHIPS 7 7 7 OVEN CURE 7 7 7 WIRE BOND RESISTORS Bond height 2-mils 10 WIRE BOND RESISTORS Bonding force- first & second bond Grams 10 Bonding power Microinchess 0-250 6 Bonding time Miliseconds 100 7 Location of first bond X-mils, Y-mils 7 7 Location of second bond X-mils, Y-mils, 7 7 7		(Repeat Above 4 Operations For	Each Additional Circuit Layer)						
ATTACH RESISTOR CHIPS ? ? OVEN CURE ? ? WIRE BOND RESISTORS Bond height ? ? WIRE BOND RESISTORS Bonding force- first & second bond Grams 10 Bonding power Microinchess 0-250 Bonding time Miliseconds 100 Location of first bond X-mils, Y-mils ? Location of second bond X-mils, Y-mils, ? ?		APPLY EPOXY	ć	2	ż				
OVEN CURE ? ? ? WIRE BOND RESISTORS Bond height 2-mils 10 Bonding force- first & second bond Grams 10 Bonding power Microinchess 0-250 Bonding time Miliseconds 100 Location of first bond X-mils, Y-mils, ? Location of second bond X-mils, Y-mils, ?		ATTACH RESISTOR CHIPS	2	2	ż				MIL-STD-883,METHOD 2019.4
OVEN CURE ? ? WIRE BOND RESISTORS Bond height 2-mils 10 Bonding force- first & second bond Grams 10 Bonding time Miliseconds 100 Location of first bond X-mils, Y-mils ? Location of second bond X-mils, Y-mils, ? ?	2310								MIL-STD-883,METHOD 5011
OVEN CURE ? ? ? WIRE BOND RESISTORS Bond height 2-mils 10 Bonding force- first & second bond Grams 10 Bonding time Microinchess 0-250 Bonding time Miliseconds 100 Location of first bond X-mils, Y-mils, ? Location of second bond X-mils, Y-mils, ?	2310								MIL-STD-883, METHOD 2017.7
WIRE BOND RESISTORS Bonding force- first & second bond Grams 2-mils 10 Bonding power Microinchess 0-250 Bonding time Miliseconds 100 Location of first bond X-mils, Y-mils, ? Location of second bond X-mils, Y-mils, ?		OVEN CURE	٠	2	٤				
Bonding force- first & second bond Grams 10 Bonding power Microinchess 0-250 Bonding time Miliseconds 100 Location of first bond X-mils, Y-mils, 7-mils, 7-		WIRE BOND RESISTORS	Bond height	Z-mils	10			Automatic	Automatic MIL-STD-883, METHOD 2011.5
Bonding power Bonding time Location of first bond X-mils, Y-mils, 7-mils, 7	2330			Grams	10			Automatic	Automatic MIL-STD-883, METHOD 2017.5
Bonding time Automatic Location of first bond X-mils, Y-mils, ? Location of second bond X-mils, ? Automatic	2330		Bonding power	Microinchess	0-250			Automatic	Automatic MIL-STD-883, METHOD 2023.3
Location of first bond X-mils, Y-mils, ? Location of second bond X-mils, ?	2330		Bonding time	Miliseconds	100			Automatic	M1L-STD-883,METHOD 5003
Location of second bond X-mils, Y-mils, ?	2330		Location of first bond	X-mils, Y-mils	2			Automatic	
[z-mits]	2330			X-mils, Y-mils, Z-mils	č			Automatic	

2330		Loop height, toop length	Mils/mils	6-20/10-200	Aut	Automatic
2330		Tail Length	Mils	2	Aute	Automatic
2330		Wire diameter	Mils	1	Auto	Automatic
2330		Wire material	\$String\$	Gold or Aluminum	Auto	Automatic
2330		Wire doping material/percentage	\$String\$	Silicon/1.0%	Auto	Automatic
2330		Wire material purity	Percent purity	66.66	Auto	Automatic
2330		Wire elongation	Percent	3-7	Auto	Automatic
2330		Wire tensile strength	Grams	15	Auto	Automatic
2330		Time from last cleaning operation	Hours, date (yymmdd)	16, 910322	Auto	Automatic
2330		Bond signature	7	غ	Auto	Automatic
2340	TRIM RESISTORS, ACITVE	Name of component to be trimmed	\$ String \$	R17	Auto	Automatic
2340	(Using Laser Process)	Location of start of trim	X-mils, Y-mils	XX.XXX, YY.YY	Auto	Automatic
2340		Coordinate data for path of trim	X-mils, Y-mils	хх.ххх, уу.уу	Aute	Automatic
2340		Pulse repetition rate	Kilohertz	35	Auto	Automatic
2340		Resistor trim geometry	\$String\$	"L", :J", or Plunge Cut	Auto	Automatic
2340		Type of leser use in trimming	\$ String \$	YAG, Co2, etc.	Auto	Automatic
2340		Laser power, maximum	Vatts	15	Auto	Automatic
2340		Laser power, minimum	Watts	12	Auto	Automatic
2340		Spot size	Microns	0.002	Auto	Automatic
2340		Target reistance	Ohms	1000	Auto	Autometic
2340		Target resistance tolerance	Ohms	+/- 0.1	Auto	Automatic
2340		Trim speed, course	Mils/second	n/a	Auto	Automatic
2340		Trim speed, fine	Mil/second	0/8	Auto	Automatic
2340		Trim kerf width	Mils	0.002 mils (spot size)	Auto	Automatic
2340		Trim width, minimum	Mils	0.010	Auto	Automatic
2340		Parameter to be measured	\$String\$	3.5 vdc at TP1	Auto	Automatic
2340		Tolerance of parameter measured	\$String\$	+/- 0.02 vdc	Auto	Automatic

2340		Operating conditions for trim	\$String\$	Vcc=5.0,a minus 55	Automatic	
2350	INSPECT	ż	٤		Automatic	
2360	TO NEXT ASSEMBLY OR STORES	n/a	n/a	n/a	n/a	n/a
	GENERIC THIN FILM ASSEMBLY PROCESS FLOW					
2400	PLASMA CLEAN	Operating frequency	MHz	13		
2400		Operating presure	Microns (Hg)	2		
2400		Power, RF	Watts	100		
2400		Cleaning time	Minutes	10		
2400		Gases for plasma	\$String\$	Oxygen, Argon, etc.		
2400		Partial pressure of atmosphere	Percent	10% Oxygen, 90% Argon		
2400		Number of units to be cleaned (load)	Unitless	ż		
2410	SCREEN CONDUCTIVE EPOXY	Screen mesh	Wire/inch	i		MIL-STD-883,METHOD 2017.7
2410		Screen tension	2	٤		MIL-STD-883,METHOD 2019.4
2410		Screen breakaway distance	Mils	2		MIL-STD-883,METHOD 5011
2410		Squeegee applied pressure	Lbs/sq.in per linear inch	1-10 psi/in. of squeegee		
2410		Squeegee deposition velocity	Inches/second	2-6		
2410		Squeegee hardness	Durometers	ć		
2410		Substrate to screen distance	Mils	2		
2410		Number of squeegee passes	Unitless	1, 2, or 3		
2410		Material properites				
2410		Material properties				
2410		Minimum layer thickness	Mils	٠		
2410		Maximum layer thickness	Nils	ż		
2410		Emulsion thickness on screen	Mils	2-3		
2410		Screen weave angle to substrate	Angular degrees	22, 45, or 90		
2410		Substrate registration to screen	X-mils, Y-mils			

2420	CURE EPOXY	ć			
2430	ATTACH ACTIVE COMPONETS	3	ن	ż	MIL-STD-883,METHOD 2017.7
2430					MIL-STD-883,METHOD 2019.4
2430					M1L-STD-883,METHOD 5011
2440	OVEN CURE	ż	2	3	MIL-STD-883,METHOD 2017.7
2440					MIL-STD-883, METHOD 2019.4
2440					MIL-STD-883, METHOD 5011
2450	APPLY NONCONDUCTIVE EPOXY	2	?	3	MIL-STD,883 METHOD 2017.7
2450	(Spot dispensing method)				MIL-STD-883,METHOD 2019.4
2450					MIL-STD-883, METHOD 5011
2460	CURE EPOXY	5	٤	2	
2470	ATTACH PASSIVE COMPONETS	2	2	غ	MIL-STD-883,METHOD 2017.7
2470					MIL-STD-883,METHOD 2019.4
2470					MIL-STD-883, METHOD 5011
2480	OVEN CURE	2	ċ	c	
2490	WIRE BOND, THERMOSONIC	Bond height	Z-mils	10	MIL-STD-883,METHOD 2011.5
2490		Bonding force-first & second bond	Grams	20-500	MIL-STD-883-METHOD 2017.5
2490		Bonding temperature - capillary	Degrees Centigrade	20	MIL-STD-883,METHOD 2017.5
2490		Bonding temperature- substrate	Degrees Centigrade	150-200	MIL-STD-883,METHOD 2023.3
2490		Bonding time-first & second bond	Milliseconds	1-999	
2490		Bonding power- first & second bond	Watts	First 1.3, Second	
2490		Ball size	Mills	0.7	
2490		Location of first bond (ball)	X-mils, Y-mils, Z-mils	5	
2490		Location of second bond (stitch)	X-mils, Y-mils, Z-mils		

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2490				002-01/02-0	
2490		Wire diameter	Mils	1-2	
		Wire tensile strength	Grams	15	
2490		Wire material	\$String\$	Plc9	
2490		Wire material purity	Percent purity	99.999	
2490		Wire doping material/percent	\$String\$	Silicone/1.0%	
2490		Wire elongation	Percent	3-7	
2490		Wire tension in bonding machine	Grams	10	
5490		Time from last cleaning operation	Hours, date (yymmdd)	16, 910322	
2500 W	WIRE BOND, ULTRASONIC	Bond height	Z-mils	10	MIL-STD-883,METHOD 2011.5
2500 ((Die to substrate)	Bonding force -first & second bond	Grems	10	MIL-STD-883,METHOD 2017.5
2500		Bonding power	Microinches	0-250	MIL-STO-883, METHOD 2023.3
2500		Bonding time	Milliseconds	100	MIL-STD-883, METHOD 5003
2500		Location of first bond	X-mils, Y-mils	2	
2500		Location of second bond	X-mils, Y-mils, Z-mils	7	
2500		Loop height, loop length	Mils/mils	6-20/10-200	
2500		Tail length	Mils	2	
2500		Wire diameter	Mils	1	
2500		Wire material	\$String\$	Gold or aluminum	
2500		Wire doping material/percentage	\$String\$	Silicon/1.0%	
2500		Wire material purity	Percent purity	99.999	
2500		Wire elongation	Percent	3-7	
2500		Wire tensile strength	Grams	15	
2500		Time from last cleaning operation	Hours, date (yymmdd)	16, 910322	
2500		Bond signature	2		
2510 W	WIRE BOND PULL TEST	Location of first bond	X-mils, Y-mils, Z-mils	2	MIL-STD-883,METHOD 2011.5

2510		Location of second bond	X-mils, Y-mils, Z-mils	2	MIL-STD-883,METHOD 2023.3
2510		Location of hook	X-mils, Y-mils, Z-mils	Ł	MIL-STD-883,METHOD 5003
2510		Hook size relative to wire size	Ratio	2:1	
2510		Applied force	Grams	3-20 (1 mil wire)	
2510		Angle of pull from normal	Degrees	0	
2510		Precondition temperature	Degrees Centigrade	300 C	
2510		Precondition time	Hours		
2510		Wire diameter	Mils		
2510		Wire material	\$String\$	Gold, Aluminum	
2510		Sample size	Unitless	20 out of 100	
2510		Failure criteria, min., ave., sigma	Grams	1.2, 2, and 3	
2520	CLEAN HEADER	Solvent name	\$String\$	Alcohol	
2520		Solvent identification data	\$String\$	Mfgrs. name, partnumber	
2520		Solvent cleaning time	Minutes	1.0 min	
2520		Solvent cleaning temperature	Degrees Centigrade	105 +/- 5	
2520		Drying time	Minutes	1.0	
2520		Drying temperature	Degrees centigrade	105 +/-5	
2530	MARK HEADER	٤	٤		
2540	CURE MARKING	2	ż	2	
2550	MOUNT SUBSTRATE TO HEADER		٤		
2560	OVEN CURE	c.	ż		
2570	WIRE BOND	Bond height	Z-mils	10	
2570	(Substrate to header)	Bonding force-first and second bond	Grams	20-500	
2570		Bonding temperature - capillary	Degrees Centigrade	20	

2570		Bonding temperature - substrate	Degrees Centigrade	150-200
2570		Bonding time - first and second bond	Milliseconds	1-999
2570		Bonding power- first and second bond	Watts	First 1.3, Second 1.3 wett
2570		Ball size	Mills	0.7
2570		Location of first bond (ball)	X-mils, Y-mils	ż
2570		Location of second bond (stitch)	X-mils, Y-mils, Z-mils	ė
2570		Loop height, loop length	Mils/mils	6-20/10-200
2570			Mils	1-2
2570		Wire tensile strength	Grams	15
2570		Vire material	\$ String \$	Cold
2570		Wire material purity	Percent purity	99.999
2570		Wire doping material/percentage	\$String\$	Silicone/1.0%
2570		Wire elongation	Percent	3-7
2570		Wire tension in bonding machine	Grams	10
2570		Time from last cleaning operation	Hours, date (yymmdd)	16 910322
2580	WIRE BOND PULL TEST	Location of first bond	X-mils, Y-mils, Z-mils	٠
2580		Location of second bond	X-mils, Y-mils, Z-mils	٠
2580		Location of hook	X-mils, Y-mils, Z-mils	٤
2580		Hook size relative to wire size	Ratio	2:1
2580		Applied force	Grams	
2580		Angle of pull from normal	Degrees	0
2580		Precondition temperature	Degree Centigrade	300
2580		Precondition time	Hours	
2580		Wire diameter	Mils	1
2580		Wire material	\$String\$	Gold, Aluminum

2580		Sample size	Unitless	20 out of 100	
2580		Failure criteria, min., ave., sigma	Grams	1.2, 2, and 3	
2590	FUNCTIONAL ELECTRICAL TEST	Test interface adapter	\$ String\$		MIL-STD-883,METHODS 3001-3015
2590		Test procedure	\$ String\$	Part number identifier	MIL-STD-883,METHODS 4001-4007
2590		Date of test	Date (yymmdd)	M 202116	MIL-STD-883, METHODS 5001-5010
2590		Electrical parameters	2	i	
2590				2.00	MIL-STD-883, METHODS 5001-5010
2600	PRE-CAP VISUAL INSPECTION	٤	٤	ė	
2610	CLEAN COVER	Solvent name	\$String\$	Alcohot	
2610		Solvent identification data	\$ String \$	Mfgrs. name, part number	
2610		Solvent cleaning time	Minutes	1.0 min	
2610		Solvent cleaning temperature	Degrees Centigrade	105 +/- 5	
2610		Drying time	Minutes	1.0 min	
2610		Drying temperature	Degrees Centigrade	5 -/+ 501	
2620	TACK COVER IN PLACE	ć	ż	٤	
2630	BAKE - 24 HR. NITROGEN	2	7	٤	
2640	BAKE - 24 HR. VACUUM	6.	,	٥	
2650	SEAL COVER	Ambient environment	Percent gas composition	90 x N 10X He	
2650	(Parallel seam weld process)	Environmental moisture level	Part/million water vapor	100	plint)
2550		Pulse repetition time	Milliseconds	80-100	
2650		Pulse width (duration)	Milliseconds	90	
2650		Table speed	Inches/minute	1-2	
2650		Weld current	Amperes	360 +/- 20	
2650		Weld force	Grams	800	

2650		Material thickness at weld edge	Mils	0.012	
2650		Material to be welded	\$String\$	Kovar	
2660	FINE LEAK TEST	6	i	ć	
2670	GROSS LEAK TEST	٤	ż	ė	
2680	MARK PACKAGE	Alpha-numeric & bar code images	2	ė	
2680		Marking locations			
2680		Legibility			
2690	CURE MARKING	Solvent resistance	ż	ć	
2700	FUNCTIONAL ELECTRICAL TEST	Test interface adapter	\$String\$	Part number identifier	MIL-STD-883, METHODS 3001-3015
2700		Test procedure	\$String\$	Part number identifier	MIL-STD-883, METHODS 4001-4007
2700		Date of test	Date (yymmdd)	911204	MIL-STD-883, METHODS 5001-5010
2700		Electrical parameters	ż	i	
2710	BURN-IN	Test chamber temperature	ż	2	MIL-STD-883, METHOD 1015.6
2710		Duration at temperature	٤	2	MIL-STD-883, METHOD 5004.7
2720	FUNCTIONAL ELECTRICAL TEST	Test interface adapter	\$String\$	Part number identifer	MIL-STD-883, 3001-3015
2720		Test procedure	\$ String \$	Part number identifier	MIL-STD-883, METHODS 4001-4007
2720		Date of test	Date (yymmdd)	911204	MIL-STD-883, METHODS 5001-5010
2720		Electrical parameters	ć	٤	
2730	STABILIZATION BAKE	Environment	S String\$	Nitrogen	MIL-STD-883, METHOD 1008.2
2730		Temperature	Degrees Centigrade	105	MIL-STD-5008.4
2730		Time	Hours	72	
2740	TEMPERATURE CYCLE	Environment	\$String\$	Nitrogen	MIL-STD-883, METHOD 1010.5
2740		Cycles	Unitless	10	MIL-STD-883, METHOD 1011.9
2740		Temperature	Degrees C/step	-65 +125	
2740		Time at each temperature cycle	Minutes	10,10	

2740		Transfer time	Seconds	9			
2750	PHYSICAL STRESS TEST	Force axis	Direction	Y ₁			MIL-STD-883,METHOD 2001.2
2750	(Using centrifuge method)	Force magnitude	g's	2000			
2750		Time subjected to force	Minutes	1			
2760	FINE LEAK SOMB	Ambient pressure vesel pressure	Pounds/square inch	30-60			
2760	(He tracer gas method) Time under pressure	Time under pressure	Minutes	120			
2760		Internal volume of package	Cubic Centimeters	-			
2770	FINE LEAK TEST	Dwell time, pressure rel. to test	Minutes	160			
2780	GROSS LEAK BOMB	Fluorocarbon type	\$String\$				
2780		Fluorocarbon temperature	Degrees Centigrade	125 +/- 5			Et .
2780		Immersion time	Seconds	30			
2790	GROSS LEAK TEST	2	7				
2800	PIND TEST	٤	2	2			MIL-STD-883, METHOD 2020.6
2810	INSPECT	2	7	2			
2820	PACKAGE & LABEL FOR SHIPPING	Prepare tracibility documents	n/a	n/a	8 /u	n/a	n/a

3.0 Thick film manufacturing process parameters

Thick film circuits are produced by the screen-printing process. Silk mesh screening is good for sign making but is not used in electronics manufacturing because of its dimentional instability and poor abrasion resistance. The mesh of choice is stainless steel, though sometimes synthetic fibers such as Dacron (polyester) or Nylon (polyamide) are used. The three key processes used to fabricate thick-film circuits are; screen-printing, drying and firing. The following is a list of processing parameters used for thick film substrates for Hybrid Microcircuits. An attempt has been made to keep the list generic so as it does not represent anyone manufacturers processing ways.

GENERIC, THICK FILM FABRICATION PROCESS FLOW

OPERA- TION #	PROCESS DESCRIPTION	PROPERTY	UNITS OF MEASURE	TYPICAL VALUE/RANGE	SPC FORMAT	DATA	PROCESS TYPE	CONTROLLING DOCUMENT
0010	IDENTIFY SUBSTRATE	Alph-numeric & bar code images	N/A	N/A				
0010		Marking locations	N/A	N/A				
0010		Legibility	N/A	N/A				
0050	CLEAN SUBSTRATE	Chemical Properties	N/A	N/A				
0030	SCREEN CIRCUIT LAYER	Screen mesh	Wires/Inch	200-325			Automatic	
0030		Screen tension	2	i			Automatic	
0030		Screen breakaway distance	Millimeters	į			Automatic	
0030		Squeegee applied pressure	lbs/sq.in per linear inch	1-10 psi/in. of squeegee			Automatic	
0030		Squeegee deposition velocity	Inches/second	2-6			Automatic	
0030		Squeegee hardness	Durometers	60-75			Autometic	
0030		Substrate to screen distance	Millimeters	30			Automatic	
0030		Number of squeegee passes	Unitless	1, 2, or 3			Automatic	
0030		Particle size material properties	Microns	10	X bar-R	Manual	Automatic	
0030		Viscosity material properties	Centipoise	200,000	X bar-R	Manual	Automatic	5
0030		Minimum Layer thickness	Millimeters	.5			Autometic	
0030		Maximum Layer thickness	Millimeters	2			Automatic	
0030		Emulsion thickness on screen	Millimeters	.38			Automatic	
0030		Screen weave angle to substrate	Angular degrees	45			Automatic	
0030		Substrate registration to screen	X-millimtrs, Y-millimtrs	+/- 2			Automatic	
0030		Screening defects	N/A	N/A	NP		Automatic	
0700	DRY CIRCUITRY	Environment	\$ Strings \$	Oven, IR tamps, etc.			Batch	
0000	(to remove volatiles)	Drying temperature	Degrees Centigrade	180			Batch	
00%0		Drying time	Minutes	5-10			Batch	

0700		Drying wavelength (IR)	Microns	>3				
0700		Min/max layer thick	Millimeter	.5/2				
0900	FIRE CIRCUITRY	Environment	\$ String \$	Oven, furnace, etc.				
0500		Temperature profile	Time vs Degrees Centigrde	5 min a 300 C, etc.				
0020		Min/Max layer thick	Millimeter	.3/1.4				
0900	INSPECT CIRCUITRY	Conductor resistivity	miliohms/sq. in.	3-100	X ber-R	Manual		
0900		Wire pull strength (1 mil gold)	Grams	5	X bar-R	Manual		
0900		Solderability Adhesion	lbs./sq. in.	400	X bar-R	Manual		
0000	SCREEN RESISTORS	Screen mesh	Wires/inch	200-325			Automatic	
0070		Screen tension	7	3			Automatic	
0200		Screen breakaway distance	Millimeters	2			Automatic	
0070		Squeegee applied pressure	Lbs/sq.in per linear inch	1-10 psi/in. of squeegee			Automatic	
0000		Squeegee deposition velocity	Inches/second	2-6			Automatic	-13154
0070		Squeegee hardness	Durometers	60 - 75			Autometic	
00700		Substrate to screen distance	Hillimeters	30			Automatic	
000		Number of squeegee passes	Unitless	1, 2, or 3			Autometic	
0000		Ink percent solids	Percent	70			Automatic	
0070		Ink viscosity	Centipoise	170,000 - 340,000	X bar-R	Marwal	Autometic	
0070		Emulsion thickness on screen	Millimeter	8.			Automatic	
0070		Screen weave angle to substrate	Angular degrees	45			Automatic	
0070		Substrate registration to screen	X-millimtrs, Y-millimtrs	+/- 2			Automatic	
0000		Area of screened resistor	Square millimeter	1600			Automatic	
0070		Effective ink resistivity	Ohm/square	.25 - 1 М	X bar-R	Manual	Automatic	
0000		Resistance stability (time a temp)	% change in value	< 0.2			Automatic	
0070		Film thickness	Angstroms (or Microns?)	300 A, 400A (or?)	X bar-R	Manual	Automatic	
0070		Minimum Line width	Millimeter	30			Automatic	

0200		Aspect ratio	Unitless	1:7			Automot	
0200		Geometry type	\$String\$	Rectangle, top hat, etc.			Automatic	
0070		Resistor to pad overlap	Millimeter	5			Autometic	
0070		Pad offshoot off resistor side	Millimeter	9			Automatic	
0200		Pad offshoot off resistor end	Millimeter	10			Automatic	
0070		Growth factor per edge	Millimeter	.5			Automatic	
0070		Etch back factor per edge	Millimeter	9.			Automatic	
0070		Corner value	Unitless	.5			Automatic	
0200		Resistor geometry resolution	Millimeter	5			Autometic	
0070		Room temperature for screening	Degrees Centigrade	22			Autometic	
0070		Room humidty for screening	Percent	09 >			Automatic	
0070		Ink storage conditions	\$String\$	Room temp on ball mill			Automatic	
00700		Ink procurement data	\$String\$	Mfgrs. name, part no.,etc			Autometic	
0070		Ink shelf life data-date of receip	Date-yymmdd	910402			Autometic	
0070		Ink shelf life	Days	80			Automatic	
0800	DRY RESISTORS	Environment	\$String\$	Oven, IR lamps, etc.			Batch	
0800	(to remove voltiles)	Drying temperture	Degrees Centigrade	180			Batch	
0080		Drying time	Minute	5-15			Batch	
0800		Drying wavelength (IR)	Micron	>3			Batch	
0600	FIRE RESISTORS	Environment	\$Srings\$	Oven, furnace, etc.				
0600		Temperature profile	Time vs. Degrees C	5 min. @ 300 C, etc				
0100	INSPECT RESISTORS	Thickness	Millimeter	.4 - 1	X bar-R	Manual		
0100		Resistance	Ohms	.1 - 5м	X bar-R	Manual		
0110	SCREEN PASSIVATION	Screen Mesh	Wires/inch	325			Automatic	
0110		Screen tension	٤	ذ			Automatic	

0110		Screen breakaway distance	Millimeter	ć			Automatic	
0110		Squeegee applied pressure	Lbs/sq.in per tinear inch	1-10 psi/in. of squeegee			Automatic	
0110		Squeegee deposition velocity	Inches/second	2-6			Automatic	
0110		Squeegee hardness	Durometers	50-75			Automatic	
0110		Substrate to screen distance	Millimeter	30			Automatic	
0110		Number of squeegee passes	Unitless	1, 2, or 3			Automatic	
0110		Solids content material properties	×	70			Automatic	
0110		Minimum layer thickness	Millimeter	,			Autometic	
0110		Maximum Layer thickness	Millimeter	2			Autometic	
0110		Emulsion thickness on screen	Millimeter	€0.			Autometic	
0110		Screen weave angle to substrate	Angular degrees	45			Automatic	
0110		Substrate registration to screen	X-millimtr, Y-millimtr	+/-2			Automatic	
0110		Material viscosity	Centopoise	70,000-300,000	X ber-R	Manual	Automatic	
0120	DRY PASSIVATION LAYER	Environment	\$String\$	Oven, IR lamps, etc.				
0120		Drying temperature	Degrees Centigrade	180				
0120		Drying time	Minute	5-15				
0120		Drying wavelength (IR)	Micron	>3				
0130	FIRE PASSIVATION	Environment	\$ String\$	Oven, furnace, etc.				
0130		Temperature profile	Time vs Degrees Centigrad	5 min. @ 300 C, etc				
0140	INSPECT PASSIVATION	Crossover capacitance	PF/IN2/2MIL	4000 MAX	X bar-R	Manual		
0110		Dielectric breakdown	Volts/MIL	100	X bar-R	Manual		
0150	TRIM RESISTORS, PASSIVE	Name of component to be trimmed	\$String\$	R17			Automatic	
0150	(Using Laser Process)	Location of start of trim	X-millimtr, Y-millimtr	хх.ххх, уу.ууу			Automatic	
0150		Coordinate data for path of trim	X-millimtr, Y-millimtr	хх.ххх, уу.ууу		-	Automatic	
0150		Pulse repetition rate	Kilohertz	35 kHz			Automatic	
0150		Resistor trim geometry	\$String\$	"L", "J" or Plunge Cut			Automatic	

0150		Type of laser used in trimming	\$String\$	YAG, Co2, etc.			Automatic	
0150		Laser power, maximum	Watt				Automatic	
0150		Laser power, minimum	Watt	12			Automatic	
0150		Spot size	Micron	2.00.0			Automatic	
0150		Resistor resistance	Oha	1000			Automatic	
0150		Resistor resistance tolerance	Ohm	+0.1			Automatic	
0150		Trim speed, course	Millimeter/second	n/a			Automatic	
0150		Trim speed, fine	Millimeter/second	n/a			Automatic	
0150		Trim kerf width	Millimeter	0.002 (spot size)			Automatic	
0150		Trim width, minimum	Millimeter	0.010			Automatic	
0160	INSPECT	٤	7	2			Automatic	
0.10	TO NEXT ASSEMBLY OR STORES	N/A	N/A	N/A	N/A	V/N	N/A	N/A
	For Multi-layer Substrates :							
0500	IDENTIFY SUBSTRATE	٤	2	2				
0210	CLEAN SUBSTRATE	Chemical properties	N/A	N/A				
0220	SCREEN CIRCUIT LAYER	Screen mesh	Wires/inch	325			Autometic	
0220		Screen tension	M deflection/lbs of force	57-73			Automatic	
0220		Screen breakaway distance	Millimeter	ć			Automatic	
0220		Squeegee applied pressure	Lbs/sq.in per linear inch	1-10 psi/in. of squeegee			Autometic	
0220		Squeegee hardness	Durometer	60-73			Automatic	
0220		Substrate to screen distance	Millimeter	30-40			Automatic	
0220		Number of squeegee passes	Unitless	1, 2, or 3			Automatic	
0220		Particle size material properties	Microns	10	X bar-R	Manual	Automatic	
0220		Viscosity material properties	Centipoise	200,000	X bar-R	Manual	Automatic	
0220		Minimum layer thickness	Millimeter	7.			Automatic	
0220		Maximum Layer thickness	Millimeter	2			Automatic	
0220		Emulsion thickness on screen	Millimeter	2-3			Automatic	

0220		Screen weave angle to substrate	Angular degrees	22, 45, or 90			Automatic	
0220		Substrate registration to screen	X-millimtr, Y-millimtr	.5			Automatic	
0220		Screening defects	N/A	N/A	NP		Automatic	
0230	DRY CIRCUITRY	Environment	\$ String \$	Oven, IR lamps, etc.				
0230		Drying temperature	Degrees C	180				
0230		Drying time	Minute	5-15				
0230		Drying wavelength (IR)	Micron	>3				
0230		Min/max layer thick	Millimeter	.5-2				
0570	FIRE CIRCUITRY	Environment	\$ String\$	Oven, furnace, etc.				
0570		Temperature profile	Time vs. Degrees C	5 min. a 300 C, etc.				0720
0540	Min/max layer thick	Millimeter	.3-1.4					
0520	INSPECT CIRCUITRY	Conductor resistivity	MilliOhms/Sq. in.	3	X bar-R	Manual		
0220		Wire pull strength (1 MIL Gold)	Grams	5	X bar-R	Manual		
0520	(Repeat Above 4 Operations For	Additional Layers As Required)	411bs.	31lbs. after aging				
0560	SCREEN DIELECTRIC LAYER	Screen mesh	Wires/inch	325			Autometic	
0560		Screen tension	7	57-73			Automatic	
0560		Screen breakaway distance	Millimeters				Automatic	
0560		Squeegee applied pressure	Lbs/sq.in per linear inch	1-10 psi/in. of squeegee			Autometic	
0560		Squeegee deposition velocity	Inches/second	2-6			Automatic	
0560		Squeegee hardness	Durometers	60-75			Automatic	
0560		Substrate to screen distance	Millimeters	09-07			Automatic	
0560		Number of squeegee passes	Unitless	1, 2, or 3			Automatic	
0560		Solids content material properties	×	70	X bar-R	Manual	Automatic	
0560		Material viscosity	Centipoise	70,000-300,000	X bar-R	Manuat	Automatic	
0560		Minimum layer thickness	Mil	-			Automatic	
0560		Maximum layer thicknes	Mils	2			Automatic	

0970		Emulsion thickness on screen	Mils	8.			Automatic	
0550		Screen weave angle to substrate	Angular degrees	57			Automatic	
0560		Substrate registration to screen	X-mils, Y-mils	+/5			Autometic	
0270	DRY DIELECTRIC LAYER	Environment	\$Strings\$	Oven, IR lamps, etc.			Batch	
0270		Drying temperature	Degrees C	180			Batch	
0270		Drying time	Minutes	5-15			Batch	
0270		Drying wavelength (1R)	Microns	>3			Batch	
0280	FIRE DIELECTRIC LAYER	Environment	\$String\$	Oven, furnace, etc.				
0280		Temperature profile	Time vs Degrees C	5 min. a 300 C, etc.				
0500	INSPECT DIELECTRIC	Crossover capacitance	PF/IN2/2MIL	0007	X bar-R	Manual		
0520		Dielectric breakdown	Volts/MIL	500M1W	X bar-R	Manuat		
0500	(Repeat Above 4 Operations For	Each Additional Circuit Layer)						
0300	APPLY EPOXY	ć	ż	i				
0310	ATTACH RESISTOR CHIPS	د	6.	٤				MIL-STD-883,METHOD 2017.7
0310								MIL-STD-883, Method 5011
0310								MIL-STD-883,METHOD 2019.4
0320	OVEN CURE	•	,	ż				
0330	WIRE BOND RESISTORS	Bond height	Z-mils	10			Automatic	MIL-STD-883,METHOD 2011.5
0330		Bonding force- first & second bond	Grams	10			Automatic	MIL-STD-883,METHOD 2011.5
0330		Bonding power	Microinchess	0-250			Autometic	MIL-STD-883,METHOD 2023.3
0330		Bonding time	Milliseconds	100		-	Automatic	M1L-STD-883,METHOD 5003
0330		Location of first bond	X-mils, Y-mils	ć			Automatic	

0330		Location of second bond	X-mils, Y-mils, Z-mils	-	Automatic	ti c
0330		Loop height, loop length	Mils/mils	6-20/10-200	Automatic	tic
0330		Tail length	Mils	2	Automatic	tic
0330		Wire diameter	Mils	1	Automatic	tic
0330		Wire material	\$String\$	Gold or Aluminum	Automatic	tic
0330		Wire doping material/percentage	\$String\$	Silicon/1.0%	Automatic	tic
0330		Wire material purity	Percent purity	666.66	Automatic	tic
0330		Wire elongation	Percent	3-7	Automatic	tic
0330		Wire tensile strength	Grams	15	Automatic	tic
0330		Time from last cleaning operation	Hours, date (yymmdd)	16, 910322	Automatic	tic
0330		Bond signature	2	ż	Automatic	tic
0340	TRIM RESISTORS, ACITVE	Name of component to be trimmed	\$String\$	R17	Automatic	tic
0340	(Using Laser Process)	Location of start of trim	X-mils, Y-mils	xx.xx, yy.yy	Automatic	tic
0340		Coordinate data for path of trim	X-mils, Y-mils	хх.ххх, уу.ууу	Automatic	tic
0340		Pulse repetition rate	Kilohertz	35	Automatic	tic
0340		Resistor trim geometry	Sstrings	"L", :J", or Plunge Cut	Automatic	tic
0340		Type of laser use in trimming	\$String\$	YAG, Co2, etc.	Automatic	tic
0340		Laser power, maximum	Watts	15	Automatic	tic
0340		Laser power, minimum	Watts	12	Automatic	tic
0340		Spot size	Microns	0.002	Automatic	tic
0340		Target reistance	Ohms	1000	Automatic	tic
0340		Target resistance tolerance	Ohms	plus/mirus 0.1	Automatic	tic
0340		Trim speed, course	Mils/second	n/a	Automatic	tic
0340		Trim speed, fine	Mil/second	n/a	Automatic	tic
0340		Trim kerf width	Mils	0.002 (spot size)	Automatic	tic
0340		Trim width, minimum	Mils	0.010	Automatic	tic
0340		Parameter to be measured	\$String\$	3.5 vdc at TP1	Automatic	tic

0340		Tolerance of parameter measured	\$String\$	plus/minus 0.02	Automatic	
0340		Operating conditions for trim	\$String\$	Vcc=5.0,∂ mirus 55 c	Automatic	
0320	INSPECT	٤	ż	٤		
0360	TO NEXT ASSEMBLY OR STORES	n/a	ה/מ	n/a	n/a	n/a
	GENERIC THICK FILM ASSEMBLY PROCESS FLOW					
00%00	PLASMA CLEAN	Operating frequency	MHZ	13		
0070		Operating pressure	Microns (Hg)	5		
0700		Power, RF	Watts	100		
0700		Cleaning time	Minutes 10			
0700		Gases for plasma	\$String\$	Oxygen, Argon, etc.		
0070		Partial pressure of atmosphere	Percent	10% Oxygen, 90% Argon		
0070		Number of units to be cleaned (load)	Unitless	1-50		
0410	SCREEN CONDUCTIVE EPOXY	Screen mesh	Wire/inch	200		И1L-STD-883,МЕТНОD 2017.7
0410		Screen tension	2	٤		MIL-STD-883,METHOD 2019.4
0410		Screen breakaway distance	Mils	٠		MIL-STD-883,METHOD 5011
0410		Squeegee applied pressure	Lbs/sq.in per linear inch	1-10 psi/in. of squeegee		
0410		Squeegee deposition velocity	Inches/second	9-2		
0410		Squeegee hardness	Durometers	02-09		
0410		Substrate to screen distance	Mils	30		
0410		Number of squeegee passes	Unitless	1, 2, or 3		
0410		Emulsion thickness on screen	Mils	. «		
0410		Screen weave angle to substrate	Angular degrees	45		
0410		Substrate registration to screen	X-mils, Y-mils	+/-2		
0410		Viscosity material properties	Rotovisco units	20		

0410		Volume resistivity material properties	ОНМ-СМ	2.5x10-4 MAX	
0410		Minimum layer thickness	Mils	.0025	
0410		Maximum Layer thickness	Mils	.0035	
0430	ATTACH ACTIVE COMPONETS		N/A	N/A	MIL-STD-883, METHOD 2017.7
0430					MIL-STD-883,METHOD 2019.4
0430					MIL-STD-883, Method 5011
0770	OVEN CURE	Oven temp	ت	150	MIL-STD-883, Method 2017.7
0770		Cure time	Hrs	2	MIL-STD-883, Method 2019.4
0770					MIL-STD-883, Method 5011
0450	APPLY NONCONDUCTIVE EPOXY	ć	٤	3	MIL-STD-883, Method 2017.7
0450	(Spot dispensing method)				MIL-STD-883, Method 2019.4
0450					MIL-STD-883, Method 5011
0470	ATTACH PASSIVE COMPONENTS		N/A	N/A	MIL-STD-883, Method 2017.7
0470					MIL-STD-883, Method 2019.4
0470					MIL-STD-883, Method 5011
0480	OVEN CURE	Oven temp	U	150	
0480		Cure time	Hrs	2	
0670	WIRE BOND, THERMOSONIC	Bond height	Z-mils	10	MIL-STD-883, Method 2011.5
0670		Bonding force - first & second bond	Grams	20-500	MIL-STD-883, Method 2017.5
0490		Ponding temperature - capillary	Degrees centigrade	20	MIL-STD-883, Method 2023.3

0670		Bonding temperature - substrate	Degrees Centigrade	150-200	MIL-STP.883, Method 5003
0490		Bonding time - first & second bond	Milliseconds	1-999	
0670		Bonding power - first & second bond	Watts	First 1.3, second	
0670		Ball size	Mills	2.0	
0490		Location of first bond (ball)	X-mills, Y-mills	i	
0670		Location of second bond (stitch)	X-mills, Y-mills, Z-mills	ذ	
0490		Loop height, loop length	Mils/mils	6-20/10-200	
0670		Wire diameter	Mils	2-1	
0490		Wire tensile strength	Grams	15	
0670		Wire material	\$String\$	Gold	
0450		Wire material purity	Percent purity	66.66	
0670		Wiring doping material/percentage	\$String\$	Silicone/1.0%	
0670		Wire elongation	Percent	3-7	
0670		Wire tension in bonding machine	Grams	10	
0670		Time from last cleaning operation	Hours, date (yymmdd)	16, 910322	
0200	WIRE BOND, ULTRASONIC	Bond height	Z-mils	10	MIL-STD-883, Method 2011.5
0200	(Die to substrate)	Bonding force - first & second bond	Grams	10	MIL-STD-883, Method 2017.5
0200		Bonding power	Microinches	0-250	MIL-STD-883, Method 2023.3
0200		Bonding time	Milliseconds	100	MIL-STD-883, Method 5003
0200		Location of first bond	X-mils, Y-mils	ć	
0200		Location of second bond	X-mills, Y-mills, Z-mills	c	
0200		Loop height, loop length	Mils/mils	6-20/10-200	
0200		Tail length	Mills	2	
0500		Wire diameter	Mills	-	
0200		Wire material	\$String\$	Gold or Aluminum	

0200		Wire doping material/percentage	\$String\$	Silicon/1.0%	
0200		Wire material purity	Percent purity	%.%	
0200		Wire elongation	Percent	3-7	
0200		Wire tensile strength	Grams	15	
0200		Time from last cleaning operation	Hours, date (yymmdd)	16, 910322	
0200		Bond signature	2	2	
0510	WIRE BOND PULL TEST	Location of first bond	X-mils, Y-mils, Z-mils	٤	MIL-STD_883, Method 2011.5
0510		Location of second bond	X-mils, Y-mils, Z-mils		MIL-STD-883, Method 2023.3
0510		Location of hook	X-mils, Y-mils, Z-mils	٤	MIL-STD-883, Method 5003
0510		Hook size relative to wire size	Ratio	2:1	
0510		Applied force	Grams	Wire size dependent	
0510		Angle of pull from normal	Degrees	0	
0510		Precondition temperature	Degrees Centigrade	300	
0510		Precondition time	Hours	1	
0510		Wire diemeter	Mills	1	
0510		Wire material	\$String\$	Gold, Aluminum	
0510		Sample size	Unitless	20 out of 100	
0510		failure criteria, min., ave., sigma	Grams	1.2, 2, and 3	
0520	CLEAN HEADER	Solvent name	\$String\$	Alcohol	
0520		Solvent identification data	\$ String \$	Mfgrs. name, part number	
0520		Solvent cleaning time	Minutes		
0250		Solvent cleaning temperature	Degrees Centigrade	105 +/-5	
0520		Drying time	Minutes	-	
0520		Drying temperature	Degrees Centigrade	105 +/-5	
0530	MARK HEADER	c.	•		
0540	CURE MARKING	è	ż		

UNIRE BOND Sonding temperature - capillary Sonding temperature - substrate Bonding time - first & second bond Grams Bonding time - first & second bond Millis Bonding power - first & second bond Millis Bonding power - first & second bond Millis Location of first bond (ball) Location of first bond (ball) Wire dameter Wiring doping material/percentage Wire elongation Wire tension in bonding mathine Grams Wire tension in bonding mathine Grams Wire tension of first bond Z-mill Location of first bond X-mill Location of first bond X-mill Location of hook X-mill Location of hook X-mill Location of hook X-mill Z-mill Location of hook X-mill Z-mill Location of hook X-mill Z-mill	٤	2	٤	
UNRE BOND Sonding force - first & second bond Grams Bonding temperature - capillary Bonding temperature - capillary Bonding temperature - capillary Bonding temperature - capillary Bonding tower - first & second bond Millis Ball size Location of first bond (ball) X-mill Location of second bond (stitch) Wire diameter Wire tensite strength Wire fameterial purity Wire fension in bonding machine Grams Wire elongation Wire tension in bonding machine Grams Wire tension of first bond Wire form last cleaning operation Wire form last cleaning operation Wire Location of first bond X-mill Location of second bond X-mill Location of second bond X-mill Location of hook X-mill Z-mill Z-	Oven temp	υ	150	
USE BOND Sonding force - first & second bond Grams Bonding temperature - substrate Bonding temperature - substrate Bonding time - first & second bond Millis Bonding power - first & second bond Millis Bonding power - first & second bond Millis Location of first bond (ball) Location of first bond (ball) Wire diameter Wire food first bond (stitch) Wire food first bond X-milli Z-mill	Cure time	Krs	2	
Sonding temperature - capillary Degree Bonding temperature - substrate Degree Bonding time - first & second bond Willis Bonding power - first & second bond Willis Bonding power - first & second bond Willis Location of first bond (ball) X-mill Location of first bond (ball) X-mill Location of second bond (stitch) X-mill Location of second bond (stitch) X-mill Wire diameter Wire material purity Grams Wire material purity Grams Wire elongation Wire elongation Hours, Wire tension in bonding machine Grams Time from Last cleaning operation Hours, Location of first bond X-mill Location of hook X-mill Z-mill Z-mill Location of hook X-mill Z-mill Z-mi	Bond height	Z-mills	10	
Bonding temperature - capillary Degree Bonding time - first & second bond Millis Bonding power - first & second bond Watts Ball size Location of first bond (ball) X-mill Location of second bond (stitch) X-mill Location of second bond (stitch) X-mill Location of second bond (stitch) X-mill Wire diameter Wire diameter Wire material Wire material purity Grams Wire elongation Wire elongation Wire tension in bonding machine Grams Time from Last cleaning operation Hours, Location of first bond X-mill Location of second bond X-mill Location of hook X-mill Z-mill	Bonding force	puod	20-500	
Bonding time - first & second bond Wills Ball size Ball size Location of first bond (ball) Location of second bond (stitch) Loop height, loop length Wire diameter Wire material Wire material Wire elongation Wire elongation Wire from last cleaning operation Wire Location of first bond Z-mill Z-mill Location of second bond Z-mill Z-mill Location of hook X-mill Z-mill	Bonding temperature - capilla	y Degrees Centigrade	20	
Bonding time - first & second bond Watts Ball size Location of first bond (ball) Location of first bond (ball) X-mill Location of second bond (stitch) Wire diameter Wire diameter Wire material Wire material Wire material Wire elongation Wire elongation Wire tension in bonding machine Wire tension of first bond Time from last cleaning operation Wire tension of first bond X-mill Location of second bond X-mill Location of second bond X-mill Z-mill Location of hook X-mill Location of hook X-mill Z-mill Z-	Bonding temperature - substra	e Degrees Centigrade	150-200	
Bonding power - first & second bond Watts Location of first bond (ball) X-mills Location of second bond (stitch) Z-mills Loop height, loop length Mills/ Wire diameter Wire material purity Percen Wire material purity Percen Wire elongation Wire elongation Time from last cleaning operation Hours, Wire tension in bonding machine Grams Time from last cleaning operation Hours, Location of first bond Z-mills Location of second bond X-mills Location of hook X-mills Z-mills Z-mills	Bonding time - first & second	pond	1-999	
Location of first bond (ball) X-mills Location of second bond (stitch) Z-mills Loop height, loop length Mills/ Wire diameter Wire material Wire material Wire elongation Wire elongation Wire tension in bonding machine Grams Time from last cleaning operation Wire tension of first bond Time from last cleaning operation X-mills Location of second bond X-mills Z-mills Z-mills Z-mills	•	poud	First 1.3, second	
Location of first bond (ball) X-mill. Location of second bond (stitch) Z-mill. Loop height, loop length Mills/ Wire diameter Wire diameter Wire tensile strength Grams Wire material purity Percen Wiring doping material/percentage \$Strin Wire elongation Percen Wire tension in bonding machine Grams Time from last cleaning operation Hours, Location of first bond X-mill Location of second bond Z-mill Location of hook X-mill Z-mill	Ball size	Mills	5-6	
Location of second bond (stitch) Loop height, loop length Wire diameter Wire material Wire material Wire material purity Wiring doping material/percentage Wiring doping material/percentage Wire elongation Wire tension in bonding machine Time from last cleaning operation Wire too of first bond X-milli Location of second bond X-milli Location of hook X-milli Z-milli Z-milli Z-milli	Location of first bond (ball)		ż	
Wire diameter Mills Wire tensile strength Grams Wire material Strin Wiring doping material/percentage Strin Wiring doping material/percentage Strin Wire elongation Percen Wire tension in bonding machine Grams Time from last cleaning operation Hours, WIRE BOND PULL TEST Location of first bond X-mill Location of second bond X-mill Location of hook X-mill Z-mill Z-mill	Location of second bond (stite		٤	
Wire diameter Wire tensile strength Wire material Wire material purity Wire alongation Wire elongation Wire tension in bonding machine Grams Time from last cleaning operation Time from last cleaning operation Hours, Location of first bond Z-mill: Location of hook X-mill: Z-mill: Z-mill:	Loop height, loop length	Mills/mills	6-20/10-200	
Wire tensile strength Grams Wire material \$Strin Wiring doping material/percentage \$Strin Wire elongation Percen Wire tension in bonding machine Grams Time from last cleaning operation Hours, WIRE BOND PULL TEST Location of first bond X-mill: Location of second bond X-mill: Location of hook X-mill: Z-mill: 2-mill:	Wire diameter	Mills	1-2	
Wire material Wire material purity Wiring doping material/percentage \$Strin Wire elongation Wire tension in bonding machine Grams Time from last cleaning operation Hours, WIRE BOND PULL TEST Location of first bond Z-mill: Location of second bond X-mill: Location of hook X-mill: Z-mill:	Wire tensile strength	Grams	15	
Wiring doping material/percentage 185trin Wire elongation Wire tension in bonding machine Grams Time from last cleaning operation Hours, WIRE BOND PULL TEST Location of first bond Location of second bond Z-mill: Location of hook X-mill: Z-mill: Z-mill: Location of hook	Wire material	\$String\$	Gold	
Wiring doping material/percentage \$String Wire elongation Wire tension in bonding machine Grams Time from last cleaning operation Hours, WIRE BOND PULL TEST Location of first bond Z-mills Location of second bond Z-mills Location of hook X-mills Z-mills Z-mills	Wire material purity	Percent purity	66.66	
Wire tension in bonding machine Grams Time from last cleaning operation Hours, WIRE BOND PULL TEST Location of first bond X-mill: Location of second bond X-mill: Location of hook X-mill: Z-mill: Z-mill:	Wiring doping material/percent	\dashv	Silicone/1.0%	
Wire tension in bonding machine Grams Time from last cleaning operation Hours, WIRE BOND PULL TEST Location of first bond Z-mill: Location of second bond Z-mill: Location of hook Z-mill: Z-mill:	Wire elongation	Percent	3-7	
WIRE BOND PULL TEST Location of first bond X-mills Location of second bond Z-mills Location of hook X-mills Z-mills Z-mills	Wire tension in bonding machin		10	
WIRE BOND PULL TEST Location of first bond X-mills, Z-mills, Location of second bond X-mills, Z-mills, Location of hook X-mills, Z-mills, Z-mills	Time from last cleaning operat	\neg	16, 910322	
Location of second bond X-mills, Z-mills, Location of hook X-mills, Z-mills, Z-mills	Location of first bond	x-mills, Y-mills, Z-mills	٤	
Location of hook X-mills, Z-mills	Location of second bond	X-mills, Y-mills, Z-mills	٤	
	Location of hook	x-mills, Y-mills, Z-mills	٤	
	Hook size relative to wire size	e Ratio	2:1	
0580 Applied force Grams	Applied force	Grams	3-20 (1 mil wire)	

0580		Angle of pull from normal	Degrees	0	
0580		Precondition temperature	Degrees Centigrade	300	
0580		Precondition time	Hours		
0580		Wire diameter	Mills		
0580		Wire material	\$String\$	Gold, Aluminum	
0580		Sample size	Unitless	20 out of 100	
0580		failure criteria, min., ave., sigma	Grams	1.2, 2, and 3	
0650	FUNCTIONAL ELECTRICAL TEST	Test interface adapter	\$ String \$	Part number identifier	MIL-STD-883, Methods 3001.3015
0590		Test procedure	\$String\$	Part number identifier	M1L-STD-883, Methods 4001-4007
0590		Date of test	Date (yymmdd)	911204	MIL-STD-883, Methods 5001-5010
0590		Electrical parameters	i	ć	
0090	PRE-CAP VISUAL INSPECTION	ż	٤	٠	
0610	CLEAN COVER	Solvent name	\$String\$	Alcohol	
0610		Solvent identification data	\$String\$	Mfgrs. name, part number	
0610		Solvent cleaning time	Minutes	1	
0610		Solvent cleaning temperature	Degrees Centigrade	105 +/-5	
0610		Drying time	Minutes	1	
0610		Drying temperature	Degrees Centigrade	105 +/-5	
0820	TACK COVER IN PLACE	-	2		
0630	BAKE-24 HR. NITROGEN	Oven temp	U	150	
0790	BAKE-24 HR. VACUUM	Oven temp	ပ	150	
0650	SEAL COVER	Ambient environment	Percent gas composition	90% м, 10% не	
0650	(parallel seam weld process)	Environmental moisture level	PPM water vapor	100	
0650		Pulse repetition time	Milliseconds	80-100	
0650		Pulse width (duration)	Milliseconds	09	
				1 - 1	

090		Table speed	Inches/minute	1-2	
0650		Weld current	Amperes	360 +/- 20	
0650		Weld force	Grams	800	
0650		Material thickness at weld edge	Mills	0.012	
0650		Material to be welded	\$String\$	Kovar	
0990	FINE LEAK TEST	Bomb time/pressure	Hrs/PSIG	4/30	
0990		Leak rate	ATM-CC/SEC	5X10-8 MAX	
0670	GROSS LEAK TEST	Bomb time/pressure	Hrs/PSIG	10/30	
0890	MARK PACKAGE	Alpha-numeric and bar code images	N/A	N/A	
0890		Marking Locations			
0890		Legibility			
0690	CURE MARKING	Solvent resistance	N/A	N/A	
0020	FUNCTIONAL ELECTRICAL TEST	Test interface adapter	\$String\$	Part number identifier	MIL-STD-883, Methods 3001-3015
0200		Test procedure	\$ String \$	Part number identifier	MIL-STD-883, Methods 4001-4007
0020		Date of test	Date (yymmdd)	911204	M1L-STD-883, Methods 5001-5010
0020		Electrical parameters	Ohms, volts, amps, time, e tc.	N/A	
0710	BURN-1N	Test chamber temperature	Ü	125	MIL-STD-883, Method 1015.6
0710		Duration at temperature	Hrs	168	M11-STD-883, Method 5004.7
0710		Functional test parameters >	N/A	N/A	
0720	FUNCTIONAL ELECTRICAL TEST	Test interface adapter	\$String\$	Part number identifier	MIL-STD-883, Methods 3001-3015
0720		Test procedure	\$String\$	Part number identifier	M1L-STD-883, Methods 4001-4007
0720		Date of test	Date (yymmdd)	911204	M1L-STD-883, Methods 5001-5010
0720		Electrical parameters	Ohms,volts,amps,time,e tc.	N/A	

0730	STABILIZATION BAKE	Environment	\$String\$	Nitrogen	MIL-SID-883, Method 1008.2
0730		Temperature	Degrees Centigrade	150	MIL-STD-883, Method 1011.9
0730		Time	Hours	24	
0740	TEMPERATURE CYCLE	Environment	\$ String \$	Nitrogen	MIL-STD-883, Method 1010.5
0740		Cycles	Unitless	10	MIL-STD-883, Method 1011.9
0740		Temperature	Degrees Centigrade/step	minus 65, plus 125	
0740		Time at each temperature cycle	Minutes	10, 10	
0740		Transfer time	Seconds	9	
0220	PHYSICAL STRESS TEST	Force axis	Direction	Y ₁	MIL-STD-883, Method 2001.2
0750	(Using centrifuge method)	Force magnitude	G's	2000	
0750		Time subjected to force	Minutes	1	
0220	FINE LEAK BOMB	Ambient pressure vessel	Pounds/square inch	30-60	
0920	(He tracer gas method)	Time under pressure	Minutes	, 120	
0920		internal volume of package	Cubic centimeters	-	
0770	FINE LEAK TEST	Dwell time, pressure rel. to test	Minutes	160	
02.20	GROSS LEAK BOMB	Flouracarbon type	\$String\$		
0200	GROSS LEAK TEST	Flouracarbon temperature	Degrees Centigrade	125 +/-5	
0220		Immersion time	Seconds	30	
0800	Pind test	د	٥	٤	MIL-STD-883, Method 2020.6
0810	INSPECT	٥	,	ż	
0820	PACKAGE & LABEL FOR SHIPPING	Prepare tracibility documents	N/A	N/A	

Hybrid Microcircuit Assembly Manufacturing Process Parameters Data List

4.0 Multi-chip module manufacturing process parameters

As the multichip module (MCM) strives to become the electronics industry's next generation hybrid microcircuit, manufacturing companies are busy seeking out the best materials and processes available to build the powerful, high speed MCM's. Three (3)-mil line and space technology increases interconnect density, improves performance and reliability, and keeps costs under control, all using existing hybrid methods. The 3-mil technology is very compatible with green tape processes because it allows the use of highly conductive precious metals (in this case, gold). Green tape is made of a slurry combining ceramic fillers with a glass matrix to form a green (unfired) tape. This tape can be cut to different lengths and stacked to form the multilayer hybrid. Using a green tape system to laminate a dielectric to a ceramic substrate is similar to producing a multilayer printed circuit board only in a thick film format. The following is a list of processing parameters used for MCM's. An attempt has been made to keep the list generic so as it does not represent anyone manufacturers processing ways.

GENERIC, MULTI-CHIP ASSEMBLY PROCESS FLOW

OPERA- TION #	PROCESS DESCRIPTION	PROPERTY	UNITS OF MEASURE	TYPICAL VALUE\RANGE	SPC FORMAT	DATA	PROCESS TYPE	CONTROLLING DOCUMENT
4400	PLASMA CLEAN	Operating frequency	MHZ	13				
4400		Operating presure	Microns (Hg)	5				
4400		Power, RF	Watts	100				
4400		Cleaning time	Minutes	10				
7400		Gases for plasma	\$String\$	Oxygen, Argon, etc.				
7400		Partial pressure of atmosphere	Percent	10% Oxygen, 90% Argon				
£075		Number of units to be cleaned (load)	Unitless	į				
4410	SCREEN CONDUCTIVE EPOXY	Screen mesh	Wire/inch	ė				MIL-STD-883,METHOD 2017.7
4410		Screen tension		٤				MIL-STD-883,METHOD 2019.4
4410		Screen breakaway distance	Mils	٤				MIL-STD-883, METHOD 5011
4410		Squeegee applied pressure	Lbs/sq.in \ linear in.	1-10 psi/in. of squeegee				
4410		Squeegee deposition velocity	Inches/second	2-6				
4410		Squeegee hardness	Durometers	٤				
4410		Substrate to screen distance	Mils	ن				
4410		Number of squeegee passes	Unitless	1, 2, or 3				
4410		Material properites	2	٤				
4410		Material properties						
4410		Minimum layer thickness	Mils	٤				
4410		Maximum layer thickness	Mils	2				
4410		Emulsion thickness on screen	Mils	2-3				
4410		Screen weave angle to substrate	Angular degrees	22, 45, or 90				
4410		Substrate registration to screen	X-mils, Y-mils	2				
4420	CURE EPOXY	6	e.	ć				

4430	ATTACH ACTIVE	6			MII - STD-883 METHON 2017 7
	COMPONETS				ייר פוף שטייבוועם בפון יי
4430					MIL-STD-883, METHOD 2019.4
4430					MIL-STD-883, METHOD 5011
0777	OVEN CURE	2	٤	2	MIL-STD-883, METHOD 2017, 7
0777					MIL-STD-883, METHOD 2019.4
7777					MIL-STD-883, METHOD 5011
4450	APPLY NONCONDUCTIVE EPOXY	2	2	٤	MIL-STD,883 METHOD 2017.7
7450	(Spot dispensing method)				MIL-STD-883,METHOD 2019.4
4450					MIL-STD-883, METHOD 5011
7460	CURE EPOXY	ż	7	2	
4470	ATTACH PASSIVE COMPONETS	2	į	2	MIL-STD-883,METHOD 2017.7
4470					MIL-STD-883,METHOD 2019.4
4470					MIL-STD-883,METHOD 5011
7480	OVEN CURE	٤	ż	2	
0677	WIRE BOND, THERMOSONIC	Bond height	2-mils	10	MIL-STD-883,METHOD 2011.5
0677		Bonding force-first & second bond	Grams	20-500	MIL-STD-883-METHOD 2017.5
7490		Bonding temperature - capillary	Degrees Centigrade	20	MIL-STD-883,METHOD 2017.5
4490		Bonding temperature- substrate	Degrees Centigrade	150-200	MIL-STD-883,METHOD 2023.3
0677		Bonding time-first & second bond	Milliseconds	1-999	
0677		Bonding power- first & second bond	Watts	First 1.3, Second	
0677		Ball size	Mills	0.7	
0677		Location of first bond (ball)	X-mils, Y-mils, Z-mils	2	
0677		Location of second bond (stitch)	X-mils, Y-mils, Z-mils	٤	
7490		Loop height, loop length	Mils/Mils	6-20/19-200	
7490		W're diameter	Mils	1-2	

0677		Wire tensile strength	Grams	15	
7490		Wire material	\$String\$	Plo9	
0677		Wire material purity	Percent purity	%.%%	
0677		Wire doping material/percent	\$S+ring\$	Silicone/1.0%	
0677		Wire elongation	Percent	3-7	
0677		Wire tension in bonding machine	Grams	10	
0677		Time from last cleaning operation	Hours, date (yymmdd)	16, 910322	
4500	WIRE BOND, ULTRASONIC	Bond height	Z-mils	10	MIL-STD-883, METHOD 2011.5
4500	(Die to substrate)	Bonding force - first & second bond	Grams	10	MIL-STD-883,METHOD 2017.5
4500		Bonding power	Microinches	0-250	MIL-STD-883, METHOD 2023.3
4500		Bonding time	Milliseconds	100	MIL-STD-883,METHOD 5003
4500		Location of first bond	X-mils, Y-mils		
4500		Location of second bond	X-mils, Y-mils, Z-mils	٠	
4500		Loop height, loop length	Mils/mils	6-20/10-200	
4500		Tail length	Mils	2	
4500		Wire diameter	Mils	1	
4500		Wire material	\$String\$	Gold or aluminum	
4500		Wire doping material/percentage	\$String\$	Silicon/1.0%	
4500		Wire material purity	Percent purity	99.999	
4500		Wire elongation	Percent	3-7	
4500		Wire tensile strength	Grams	15	
4500		Time from last cleaning operation	Hours, date (yymmdd)	16, 910322	
4500		Bond signature	٤		
4510	WIRE BOND PULL TEST	Location of first bond	X-mils, Y-mils, Z-mils	٠	MIL-STD-883,METHOD 2011.5
4510		Location of second bond	X-mils, Y-mils, Z-mils	ć	MIL-STD-883,METHOD 2023.3
4510		Location of hook	X-mils, Y-mils, 2-mils	ċ	M1L-STD-883,METHOD 5003

4510		Hook size relative to wire size	Ratio	2:1
4510		Applied force	Grams	3-20 (1 mil wire)
4510		Angle of pull from normal	Degrees	0
4510		Precondition temperature	Degree Centigrade	300
4510		Precondition time	Hours	
4510		Wire diameter	Mils	
4510		Wire material	\$String\$	Gold, Aluminum
4510		Sample size	Unitless	20 out of 100
4510		Failure criteria, min.,ave.,sigma	Grams	1.2, 2, and 3
4520	CLEAN HEADER	Solvent name	\$String\$	Alcohol
4520		Solvent identification data	\$String\$	Mfgrs. name, partnumber
4520		Solvent cleaning time	Minutes	1.0
4520		Solvent cleaning temperature	Degrees Centigrade	105 +/- 5
4520		Drying time	Minutes	1.0
4520		Drying temperature	Degrees Centigrade	105 +/-5
4530	MARK HEADER	2	2	2
4540	CURE MARKING	2	?	2
4550	MOUNT SUBSTRATE TO HEADER	٤	7	2
4560	OVEN CURE	2	٤	2
4570	WIRE BOND	Bond height	Z-mīls	10
4570	(Substrate to header)	Bonding force-first and second bond	Grams	20-500
4570		Bonding temperature - capillary	Degrees Centigrade	20
4570		Bonding temperature - substrate	Degrees Centigrade	150-200
4570		Bonding time - first and second bond	Milliseconds	1-999
4570		Bonding power- first and second bond	Watts	First 1.3, Second
4570		Ball size	Mills	0.7

	4570		Location of first bond (ball)	X-mils, Y-mils	2	
Uire dissect Vire tensile strength Vire tensile strength Strings 1-2	4570		second bond (stitch)		٤	
Wire diameter Wile Free diameter Free diameter <td>4570</td> <td></td> <td>Loop height, loop length</td> <td>Mils/mils</td> <td>6-20/10-200</td> <td>101</td>	4570		Loop height, loop length	Mils/mils	6-20/10-200	101
Wire tensile strength Grams 15 Wire material String\$ Gold Wire material purity Percent purity 99,999 Wire doping material/percentage String\$ \$1icone/1.0X Wire tension in bonding machine Percent 3-7 Wire England in bonding machine Percent 3-7 WIRE BOND PULL TEST Location of first bond X-mils, Y-mils, 7 WIRE BOND PULL TEST Location of first bond X-mils, Y-mils, 7 Location of first bond X-mils, Y-mils, 7 7 Mobile of pull from of second bond X-mils, Y-mils, 7 7 Mobile of pull from normal Degrees 30 Mobile of pull from normal Degrees 30 Mobile of pull from normal Degrees 30 Wire diameter Wire diameter Mils Wire diameter String\$ 1 Sample size Unitless 20 out of 100 Failure criterial, min., ave., grams 11.2, 2, and 3 Functional fleetifier String\$ Part number String\$ <	4570		Wire diameter	Mils	1-2	
Vire material purity Percent purity 90.999	4570		Wire tensile strength	Grams	15	
Wife material purity Percent purity 90.999 Usine doping material/percentage Strings Silicone/1.0% Usine elongation Percent 3-7 Usine tension in bonding machine Grams 10 VAIRE BOND PULL TEST Location of first bond X-mils, Y-mils, 7-mils,	4570		Vire material	\$String\$	Gold	
Vire doping material/percentage Sstrings Silicone/1.0% Vire elongation Percent 3-7 VIRE BOND PULL TEST Time from last cleaning operation Normils, Y-mils, 7 VIRE BOND PULL TEST Location of first bond X-mils, Y-mils, 7 VALIE BOND PULL TEST Location of second bond X-mils, Y-mils, 7 Location of second bond X-mils, Y-mils, 7 Location of hook X-mils, Y-mils, 7 Applied force Z-mils Applied force Grams Angle of pull from normal Degrees Decordition time Nours Vire material SStrings Gold, Aluminam Sample size Precordition time Unitless Sample size Unitless Failure criteria, min., ave., grams Gold, Aluminam FEST Part runter TEST Part runter	4570		Wire material purity	Percent purity	99.999	
Value BOND PULL TEST Value action of first bond operation X-mils browthine of rems Time from Last cleaning operation of first bond of first bond of second bond operation of hook operation ope	4570		Wire doping material/percentage	\$String\$	Silicone/1.0%	
Vire tension in bonding machine Grams 10 VIRE BOND PULL TEST Time from last cleaning operation N-mils, Y-mils, P-mils,	4570		Wire elongation	Percent	3-7	
VIRE BOND PULL TEST Time from last cleaning operation in first bond X-mils, Y-mils, P-mils, P	4570		Wire tension in bonding machine	Grams	10	
WIRE BOND PULL TEST Location of first bond X-mils, Y-mils, T-mils, T-	4570		Time from last cleaning operation			
Location of second bond X-mils, Y-mils, Paris	4580	WIRE BOND PULL TEST		X-mils, Y-mils, Z-mils	2	
Location of hook X-mils, Y-mils, Parils Precipe Centification to more size Ratio 2:1	4580				٤	
Hook size relative to wire size Ratio 2:1	4580				٤	
Applied force Grams 7 Angle of pull from normal Degrees 0 Precondition temperature Degree Centigrade 300 Wire diameter Mils 1 Wire diameter Mils 1 Wire material \$String\$ Gold, Aluminum Sample size Unitless 20 out of 100 FUNCTIONAL ELECTRICAL Test interface adapter \$String\$ FUNCTIONAL ELECTRICAL Test interface adapter \$String\$ TEST Pert number	4580			Ratio	2:1	
Angle of pull from normal Degree Centigrade 300 Precondition temperature Degree Centigrade 300 Wire diameter Hours 1 Wire material \$String\$ Gold, Aluminum Sample size Unitless 20 out of 100 Failure criteria, min., ave., sigma 1.2, 2, and 3 FUNCTIONAL ELECTRICAL Test interface adapter \$String\$ Part rumber TEST Test procedure \$String\$	4580		Applied force	Grams		
Precondition temperature Degree Centigrade 300 Wire diameter Hours 1 Wire material \$String\$ Gold, Aluminum Sample size Unitless 20 out of 100 Failure criteria, min., ave., sigma Grams 1.2, 2, and 3 FUNCTIONAL ELECTRICAL Test interface adapter \$String\$ Part number TEST Test procedure \$String\$ Part number	4580		Angle of pull from normal	Degrees	0	
Precondition time Hours 1 Wire diameter Mils 1 Wire material \$String\$ Gold, Aluminum Sample size Unitless 20 out of 100 Failure criteria, min., ave., sigma Grams 1.2, 2, and 3 FUNCTIONAL ELECTRICAL Test interface adapter \$String\$ Part number identifier TEST Test procedure \$String\$ Part number	4580		Precondition temperature		300	
Wire diameter Mils 1 Wire material \$String\$ Gold, Aluminum Sample size Unitless 20 out of 100 Failure criteria, min., ave., sigma Grams 1.2, 2, and 3 FUNCTIONAL ELECTRICAL Test interface adapter \$String\$ Part number TEST Test procedure \$String\$ Part number	4580		Precondition time	Hours		
Wire material \$String\$ Gold, Aluminum Sample size Unitless 20 out of 100 Failure criteria, min., ave., Grams 1.2, 2, and 3 sigma FUNCTIONAL ELECTRICAL Test interface adapter \$String\$ Part number identifier TEST Test procedure \$String\$ Part number	4580		Wire diameter	Hils	1	
Sample size Unitless 20 out of 100	4580		Wire material	\$String\$	Gold, Aluminum	
Failure criteria, min., ave., Grams 1.2, 2, and 3 sigma sigma FUNCTIONAL ELECTRICAL Test interface adapter SString\$ Part number identifier TEST SString\$ Part number	4580		Sample size	Unitless	20 out of 100	
FUNCTIONAL ELECTRICAL Test interface adapter SString\$ Part number identifier identifier TEST SString\$ Part number	4580		e criteria, min., ave	Grems	2,	
Test procedure SString\$ Part number	4590	FUNCTIONAL ELECTRICAL TEST	Test interface adapter	\$ String \$	Part number identifier	M1L-STD-883,METHODS 3001-3015
	4590		Test procedure		Part number identifier	MIL-STD-883, METHODS 4001-4007

7290		Date of test	Date (yymmdd)	911204	MIL-STD-883, METHODS 5001-5010
4590		Electrical parameters	2		
4590					MIL-STD-883, METHODS 5001-5010
7600	PRE-CAP VISUAL INSPECTION	3	٤		
4610	CLEAN COVER	Solvent name	\$String\$	Alcohol	
4610		Solvent identification data	\$String\$	Mfgrs. name, part number	
4610		Solvent cleaning time	Minutes	1.0	
4610		Solvent cleaning temperature	Degrees Centigrade	105 +/- 5	
4610		Drying time	Minutes	1.0	
4610		Drying temperature	Degrees Centigrade	105 +/- 5	
4620	TACK COVER IN PLACE	٤	2		
4630	BAKE - 24 HR. NITROGEN		?		
7640	BAKE - 24 HR. VACUUM	٤	2		
7650	SEAL COVER	Ambient environment	Percent gas composition	90 X N 10X He	
4650	(Parallel seam weld process)	Environmental moisture level	Parts/million water vapor	100	
4650		Pulse repetition time	Milliseconds	80-100	
4650		Pulse width (duration)	Milliseconds	9	
4650		Table speed	Inches/minute	1-2	
4650		Weld current	Amperes	360 +/- 20	
4650		Weld force	Grams	800	
4650		Material thickness at weld edge	Mils	0.012	
4650		Material to be welded	\$String\$	Kovar	
0997	FINE LEAK TEST	Helium leak rate	ć	PPM Oxygen	
4670	GROSS LEAK TEST	Sealer atmosphere	ć	PPM moisture	
7680	MARK PACKAGE	Alpha-numeric & bar code images	ć	-	
7680		Marking locations			

7680		Legibility			
0697	CURE MARKING	Solvent resistance	ż	i	
4700	FUNCTIONAL ELECTRICAL TEST	Test interface adapter	\$String\$	Part number identifier	MIL-STD-883, METHODS 3001-3015
4700		Test procedure	\$String\$	Part number .entifier	MIL-STD-883, METHODS 4001-4007
700		Date of test	Date (yymmdd)	911204	MIL-STD-883, METHODS 5001-5010
4700		Electrical parameters	ż		
4710	BURN-IN	Test chamber temperature	٤	i	MIL-STD-883, METHOD 1015.6
4710		Duration at temperature	٤	2	
4710		Functional test parameters	٤	غ	
7.20	FUNCTIONAL ELECTRICAL TEST	Test interface adapter	\$String\$	Part number identifer	MIL-STD-883, 3001-3015
4720		Test procedure	\$String\$	Part number identifier	MIL-STD-883, METHODS 4001-4007
4720		Date of test	Date (yymmdd)	911204	MIL-STD-883, METHODS 5001-5010
4720		Electrical parameters	5		
4730	STABILIZATION BAKE	Environment	\$String\$	Nitrogen	MIL-STD-883, METHOD 1008.2
4730		Temperature	Degrees Centigrade	105	MIL-STD-5008.4
4730		Time	Hours	24	
4740	TEMPERATURE CYCLE	Environment	\$String\$	Nitrogen	MIL-STD-883, METHOD 1010.5
4740		Cycles	Unitless	10	MIL-STD-883, METHOD 1011.9
2740		Temperature	Degrees C/step	-65 +125	
4740		Time at each temperature cycle	Minutes	10,10	
4740		Transfer time	Seconds	9	
4750	MECH. CLEAN ROOM ATMOSPHERE	Lead length particle count	millimeter	+/- sub-micron particles	
4760	PHYSICAL STRESS TEST	Force axis	Direction	Y sub> 1	MIL-STD-883,METHOD 2001.2
4760	(Using centrifuge method)	Force magnitude	6/8	2000	
4760		Time subjected to force	Minutes		

4770	FINE LEAK BOMB	Ambient pressure veset pressure	Pounds/square inch	30-60			
4770	(He tracer gas method) Time under pressure		Hinutes	120			
4770		Internal volume of package	Cubic Centimeters	-			
4780	FINE LEAK TEST	Dwell time, pressure rel. to test	to test Minutes	160			
4790	GROSS LEAK BOMB	Fluorocarbon type	\$String\$				
4790		Fluorocarbon temperature	Degrees Centigrade	125 +/- 5			
4790		Immersion time	Seconds	30			
4800	GROSS LEAK TEST	3	٤	i			
4810	PIND TEST	2	Percent yield	2		MIL-S	MIL-STD-883, METHOD 2020.6
4820	INSPECT	2	2	٤			
4830	PACKAGE & LABEL FOR SHIPPING	Prepare tracibility documents	n/a	n/a	e /u	e/u e/	

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